

Prediction of beef carcass composition and tissue distribution using ultrasound scanning

N.R. Lambe, D.W. Ross, E.A. Navajas, J.J. Hyslop, N. Prieto, C. Craigie, L. Bunger, G. Simm, R. Roehe

SAC, Edinburgh, United Kingdom

Email: nicola.lambe@sac.ac.uk

Introduction Weight, proportion and distribution of fat and muscle in beef carcasses are of importance in order to maximise economic value and reduce waste. *In-vivo* ultrasound-measured predictors of cattle carcass composition could be of use when taken at the beginning of the finishing period (to allocate feeding groups and levels or for early selection of potential breeding stock), or pre-slaughter (to market-select finished animals, sort carcasses on quality, or feed back information from slaughter animals to breeding programmes). The aims of this study were to investigate the ability of ultrasound-measured fat and muscle depths to predict carcass composition and tissue distribution and to quantify the relative accuracy of predictions using ultrasound measurement taken at the start or end of the finishing period.

Materials and methods Live weight (LWT) and ultrasound measurements (muscle depth (UMD) and four fat depths (UFD) over the 3rd lumbar vertebra; four UFD measurements over the 12th thoracic vertebra) were measured on 52 crossbred steers and 10 heifers at the start and end of the finishing period (average age 482 and 576 d, respectively). Animals were slaughtered in batches, depending on weight and visual predictions of carcass grade, and one carcass side was fully dissected. Stepwise multiple linear regression analyses were performed in Genstat (Payne *et al.*, 2005) to determine the best combinations of predictor traits (LWT, UMD, UFD) to predict: total weights of fat and muscle in the carcass side (CF and CM, respectively), the forequarter (FQF, FQM) and hindquarter (HQF, HQM); CF and CM as proportions of carcass side weight (CF%SD, CM%SD); FQF and FQM as proportions of carcass side weight (FQF%SD, FQM%SD); HQF and HQM as proportions of carcass side weight (HQF%SD, HQM%SD); HQF as a proportion of total fat weight in the carcass side (HQF%F); HQM as a proportion of total muscle weight in the carcass side (HQM%M).

Three models (M1-M3) were tested for each carcass trait that used LWT and informative ultrasound data from: (1) pre-finishing; (2) post-finishing; or (3) pre-finishing and post-finishing. Individual UFD measurements (max. 8, if all contributed towards a reduction in residual standard deviation) were used in the models, rather than averaging UFD measurements at each site. Only LWT and UMD were tested in models to predict muscle traits and only LWT and UFD were used in models to predict fat traits, in order to minimise confounding between fat and muscle traits.

Results As expected, higher prediction accuracies (adjusted R^2) were generally achieved using measurements taken post-finishing than pre-finishing, although combining both substantially increased adjusted R^2 values (Table 1). Fat weights and proportions (of total carcass side) were predicted with higher accuracy than muscle traits. For muscle traits, weights were predicted more accurately than their proportions, whereas there was an opposite trend for fat traits. The proportion of the carcass side weight consisting of muscle in the forequarter (FQM%SD), in particular, was poorly predicted using all models.

Table 1 Adjusted R^2 values for each model describing each carcass trait (values >0.05 significantly different from zero)

Carcass trait	M 1 (pre)	M 2 (post)	M 3 (pre + post)	
CF	0.53	0.69	0.84	Muscle weight in the hindquarter expressed as a proportion of total muscle in the carcass side (HQM%M) could be predicted with moderate accuracy using the models including post-finishing measurements, but hindquarter fat weight expressed as a proportion of total fat in the carcass side (HQF%F) could not be predicted accurately.
CM	0.44	0.47	0.58	
CF%SD	0.67	0.71	0.84	
CM%SD	0.33	0.25	0.40	
FQF	0.51	0.63	0.76	
HQF	0.49	0.68	0.81	
FQM	0.38	0.45	0.54	
HQM	0.44	0.47	0.59	
FQF%SD	0.64	0.65	0.79	
HQF%SD	0.64	0.71	0.83	
FQM%SD	0.23	0.11	0.23	
HQM%SD	0.32	0.34	0.49	
HQF%F	0.09	0.03	0.10	
HQM%M	0.08	0.31	0.39	

Conclusions Ultrasound tissue depths measured before and after finishing, combined with live weight (M3), can predict fat weights and proportions in beef carcasses and carcass quarters with high accuracy, and muscle weights and proportions with moderate accuracy. Pre-finishing measurements alone (M1) give moderate predictions of composition traits and improve predictions when combined with post-finishing data (M2 vs. M3). The ability of these measurements to distinguish between animals with more of their fat or muscle in one quarter was poor. However, prediction equations specialised for different carcass regions, rather than the whole carcass, may be more appropriate to target certain markets or allow greater flexibility for selection.

Acknowledgements SAC receives funding from the Scottish Government.

References

Payne, R.W., Murray, D.M., Harding, S.A., Baird, D.B. and Soutar, D.M. 2005. GenStat for Windows (8th Edition) Introduction. VSN International, Hemel Hempstead.